CLAIMS

1. A carrier phase GPS positioning device, comprising:

a first integer ambiguity estimation unit that associates variance data in a first duration extracted from data received from a satellite by a reference station at a fixed position, with data received from the satellite by a mobile station in a second duration shorter than the first duration, and estimates an integer ambiguity included in a carrier phase accumulation value of signals transmitted from the satellite received by the mobile station; and

a positioning unit that determines the position of the mobile station using the integer ambiguity estimated by the first integer ambiguity estimation unit.

2. The carrier phase GPS positioning device as claimed in claim 1, wherein abnormal values are excluded from the variance data.

3. The carrier phase GPS positioning device as claimed in claim 1, wherein when reception of an electromagnetic wave emitted from the satellite is temporarily interrupted, data prior to the interruption

is excluded from the variance data.

4. The carrier phase GPS positioning device as claimed in claim 1, wherein

the variance data in the first duration includes a plurality of carrier phase accumulation values of the signals transmitted from the satellite at a first number of times in the first duration; and

the first integer ambiguity estimation unit associates the carrier phase accumulation values on the reference station side at the first number of times, with a plurality of carrier phase accumulation values on the mobile station side at a second number of times, and estimates the integer ambiguity included in the carrier phase accumulation values of the signals transmitted from the satellite received by the mobile station, said second number being less than the first number.

5. The carrier phase GPS positioning device as claimed in claim 3, wherein

the variance data in the first duration includes a plurality of carrier phase accumulation values of the signals transmitted from the satellite at a first number of times in the first duration; and

the first integer ambiguity estimation unit

associates the carrier phase accumulation values on the reference station side at the first number of times, with a carrier phase accumulation value on the mobile station side at one time, and estimates the integer ambiguity included in the carrier phase accumulation value of signals transmitted from the satellite received by the mobile station.

6. The carrier phase GPS positioning device as claimed in claim 3, wherein after the first integer ambiguity estimation unit estimates the integer ambiguity, the positioning unit determines the position of the mobile station using data measured on the mobile station side alone.

7. The carrier phase GPS positioning device as claimed in claim 4, further comprising:

a movement quantity detection unit that detects a movement of the mobile station and a movement quantity of the mobile station when the mobile station is moving;

a second integer ambiguity estimation unit that, when the mobile station is at rest, estimates the integer ambiguity included in the carrier phase accumulation value of the signals transmitted from the

satellite received by the mobile station, said estimation being made based on a plurality of carrier phase accumulation values on the reference station side and a plurality of carrier phase accumulation values on the mobile station side at a plurality of times in the period when the mobile station is at rest; and

a third integer ambiguity estimation unit that, while the mobile station is moving, estimates the integer ambiguity included in the carrier phase accumulation value of the signals transmitted from the satellite received by the mobile station while taking movement quantity detection results into consideration.

8. The carrier phase GPS positioning device as claimed in claim 7, wherein

after the second integer ambiguity estimation unit or the third integer ambiguity estimation unit estimates the integer ambiguity, the positioning unit determines the position of the mobile station using the integer ambiguity estimated by the second integer ambiguity estimation unit or the third integer ambiguity estimation unit instead of the integer ambiguity estimated by the first integer ambiguity estimation unit.

9. The carrier phase GPS positioning device as

claimed in claim 7, wherein

the mobile station is a vehicle having wheels;

the movement quantity detection unit detects a movement of the vehicle based on a wheel speed sensor that detects a rotational speed of the wheels;

when a slip ratio greater than a predetermined value is detected by at least the wheel speed sensor, the integer ambiguity estimation processing by the third integer ambiguity estimation unit is initialized, and the positioning unit determines the position of the mobile station using the integer ambiguity estimated by the first integer ambiguity estimation unit until the third integer ambiguity estimation unit estimates or re-estimates the integer ambiguity.

10. The carrier phase GPS positioning device as claimed in claim 1, wherein

when a plurality of reference stations is present in a communication region, the reference station is selected which is able to communicate with more satellites in common with the satellite communicating with the mobile station, and

the variance data related to the selected reference station is used.

11. The carrier phase GPS positioning device as claimed in claim 10, wherein

when there are plural of the reference stations able to communicate with the same number of the satellites, the reference station is selected which has the highest minimum reception strength of signals from the satellites.

12. The carrier phase GPS positioning device as claimed in claim 1, wherein

when a plurality of reference stations, which receives signals from a plurality of common satellites and the signal reception strength with each of the common satellites exceeds a predetermined value, is present in a communication region, the reference station is selected which is closest to the mobile station, and

the variance data related to the selected reference station is used.

13. A carrier phase GPS positioning method, comprising the steps of:

associating variance data in a first duration extracted from data received by a reference station at a fixed position from a satellite, with data received from the satellite by a mobile station in a second duration

shorter than the first duration, and estimating an integer ambiguity included in a carrier phase accumulation value of signals transmitted from the satellite received by the mobile station; and

determining the position of the mobile station using the estimated integer ambiguity.

14. A carrier phase GPS positioning method, comprising the steps of:

acquiring a carrier phase accumulation value at one time on the mobile station side;

acquiring a plurality of carrier phase accumulation values at a plurality of times prior to the one time on the reference station side;

associating the carrier phase accumulation values on the reference station side at the plural times, with a carrier phase accumulation value on the mobile station side at the one time, and estimating an integer ambiguity included in the carrier phase accumulation value of signals transmitted from the satellite received by the mobile station.

15. A carrier phase GPS positioning system, comprising:

a reference station that extracts variance

data in a first duration based on received data from a satellite;

a carrier phase GPS positioning device including a first integer ambiguity estimation unit that associates the variance data with data received from the satellite by a mobile station in a second duration shorter than the first duration, and estimates an integer ambiguity included in a carrier phase accumulation value of signals transmitted from the satellite received by the mobile station; and a positioning unit that determines the position of the mobile station using the estimated integer ambiguity; and

a communication path that enables communication between the carrier phase GPS positioning device and the reference station.

16. A reference station that extracts variance data in a predetermined duration based on received data from a satellite, and transmits the variance data to a carrier phase GPS positioning device including an estimation unit that associates the variance data with data received from the satellite by a mobile station, and estimates an integer ambiguity included in a carrier phase accumulation value received by the mobile station from the satellite; and a positioning unit that

determines the position of the mobile station using the estimated integer ambiguity.

17. A reference station, comprising:

an acquisition unit that acquires a carrier phase accumulation value at one time on a mobile station side;

an integer ambiguity estimation unit that associates a plurality of the carrier phase accumulation values at a plurality of times prior to the one time on the reference station side, and estimates an integer ambiguity included in the carrier phase accumulation value of signals transmitted from the satellite received by the mobile station;

a positioning unit that determines the position of the mobile station using the integer ambiguity estimated by the integer ambiguity estimation unit; and

a transmission unit that transmits the position detected by the positioning unit to the mobile station.